Electrogastrogram Changes Due to Shiatsu Stimulation of the Lower Leg

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I. Introduction

In the 22nd through the 29th congresses of the Japan College Association of Oriental Medicine, we reported on the effects of shiatsu stimulation on the circulatory system[1-3] (reduction in heart rate and blood pressure, peripheral increase in muscle blood volume, and rise in skin temperature) and the musculoskeletal system[4-8] (improvements in muscle pliability and spinal range of motion).

It is claimed that shiatsu stimulation clinically has a normalizing effect on internal organ function. Here, we report on whether shiatsu stimulation has an effect on gastrointestinal motility as tested using an electrogastrograph, which permits noninvasive measurement of gastric motility.

II. Methods

1. Subjects

Research was conducted on 21 healthy adult students from this college, including 15 males and 6 females (average age: 37.0 years old). Test procedures were fully explained to each test subject and their consent obtained. They were also asked to refrain from receiving shiatsu or other stimulation on the day of testing.

2. Test period

June 17 to September 16, 2006, between 2PM and 5PM

3. Test location

Testing was conducted in the shiatsu research lab at the Japan Shiatsu College. Room temperature was 26.3 ± 1.3°C and humidity was 58.3 ± 12.9%.

4. Measurement device (Fig. 1)

Electrogastrograph (NIPRO)

5. Stimulation

The lateral crural region was selected as the area to be stimulated, as previous research showed that treatment of this region using basic Namikoshi shiatsu procedure resulted in reductions in blood pressure and heart rate[1-3], and we were interested to observe what effect it would have on gastric motility. Stimulation was carried out according to standard Namikoshi procedure[9], as indicated below.

(1) Area of stimulation (Fig. 2)

[1] Point 1, lateral crural region (corresponding to Zusanli [ST36][10])

[2] 6 points, lateral crural region

(2) Method of stimulation

The left and right crural regions were treated using standard pressure (pressure gradually increased,

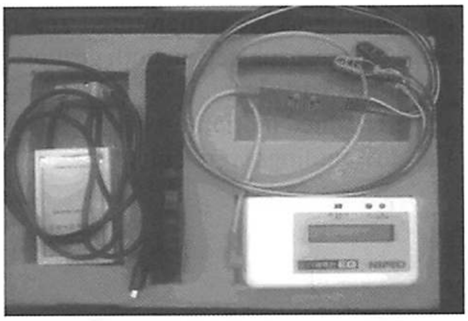

Fig. 1. Electrogastrograph (EG)

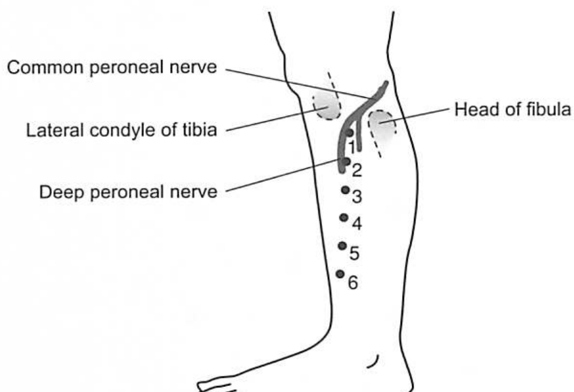

Fig. 2. Area of shiatsu stimulation (left lateral crural region)

sustained, and gradually decreased), with pressure to Point 1 sustained for 5 seconds, repeated 3 times, and pressure to the 6 points of the lateral crural region applied for 3 seconds per point, repeated 4 times.

Stimulation was applied by 2 therapists, with pressure regulated so as to be pleasurable for the test subject.

6. Test procedure

The overall condition of the test subjects, which consisted of a stimulation group and a non-stimulation group, was determined by asking them to fill out a survey including questions on physical condition, meal times, and usual abdominal condition. Measurement electrodes were applied as per the NIPRO electrogastrograph's operating manual (Fig. 3).

(1) Stimulation group

[1] 10 minutes rest (supine position)
[2] 5 minutes treatment (bilateral treatment of Point 1, lateral crural region and the 6 points of the lateral crural region)
[3] 15 minutes rest (supine position)

Measurement was carried out during the 30 minutes in which the above procedures [1] - [3] were applied. After measurement was completed, test subjects were asked to complete a survey to determine their feelings on the experimental environment, amount of shiatsu pressure, and changes in abdominal condition due to treatment.

(2) Non-stimulation group

30 minutes rest (supine position)

(3) Test precautions

The following items were monitored and recorded during testing for test subjects in both groups:
[1] that they remained alert
[2] that they remained motionless
[3] that the surroundings were quiet

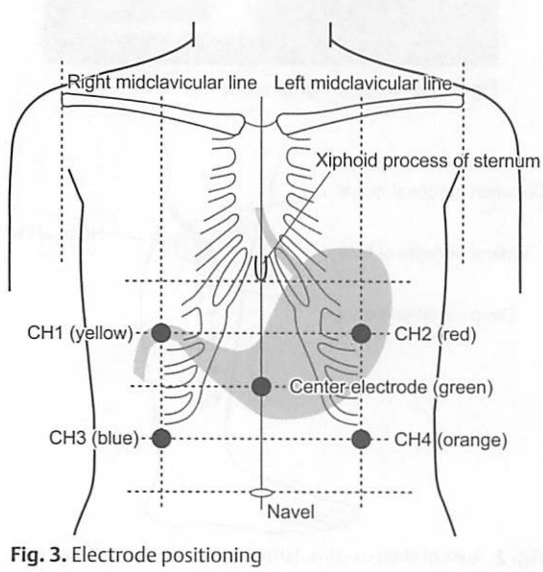

Fig. 3. Electrode positioning

(4) Other

Regarding test subjects' meals on the day of testing, preliminary testing compared response to shiatsu stimulation on both full and empty stomachs and found no difference, therefore no limitations on meal times were established for this experiment.

7. Outcome measures and analytical objects

(1) Outcome measures

[1] Dominant power (hereafter, DP)
Indicator of the degree of peristalsis
[2] Frequency
Number of peristaltic contractions per minute

Stomach peristalsis normally occurs at 3 contractions per minute. Because the normal range is that figure ± 1, peristalsis has been classified in similar papers to this one[11] as slow-wave (greater than or equal to 0 but less than 2), normal-wave (greater than or equal to 2 but less than or equal to 4), and fast-wave (greater than 4 but less than or equal to 9).

(2) Analytic object data

The object was defined as those subjects in whom DP fluctuations decreased during the pre-treatment rest period, with the objective set at less than 5% variation between the 7-minute mark and 10-minute mark of the rest period. As a result, 18 of the 21 subjects in the stimulation group and 6 of the 6 subjects in the non-stimulation group were included in the analytic object data.

(3) Evaluation period (Fig. 4)

The electrogastrograph data was analyzed before, during, and after stimulation, as shown below.
[1] Pre-treatment (control value): Average value over 3 minutes immediately prior to treatment
[2] During treatment: Average value over 5 minutes during treatment
[3] Post-treatment: Average value over 5 minutes immediately following treatment

The control value was taken from data during minutes 7–10 of the 10-minute pre-treatment rest period, when data fluctuations were absent.

(4) Statistical processing

For frequency, multiple comparison procedure was conducted using the F-test after conducting analysis of variance of the two-way layout of the average values between each channel. The significance level was <5%.

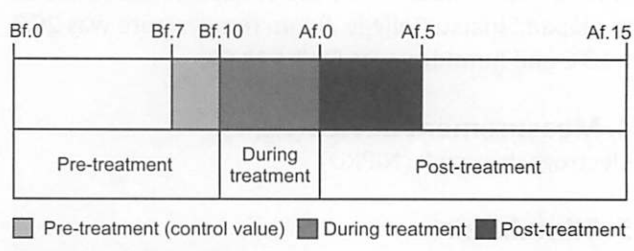

Fig. 4. Evaluation period

III. Results

1. Comparison of dominant power (DP)

An increase of DP over the control value was observed in 2 of 6 subjects in the non-stimulation group and 15 of 18 subjects in the stimulation group, indicating that the DP increase in the stimulation group was significant.

Concerning DP peak, of the 15 members of the stimulation group showing increased DP, 3 subjects peaked during the 5 minutes of treatment and 12 subjects peaked during the 5 minutes post-treatment, indicating a trend for the DP peak to occur post-treatment (Table 1). A typical example of DP response is shown in Figure 5.

When DPs of each channel were compared, it was found that DP increased over the control value in 14 subjects for CH1, 15 subjects for CH2, 15 subjects for CH3, and 11 subjects for CH4. For all channels, DP peak occurred after completion of treatment, and was significant for CH1-3 (Table 2).

Table 1. Comparison of DP peaks

	During treatment	Post-treatment
Stimulation group	3	12
Non-stimulation group	2	

(Unit: number of people)

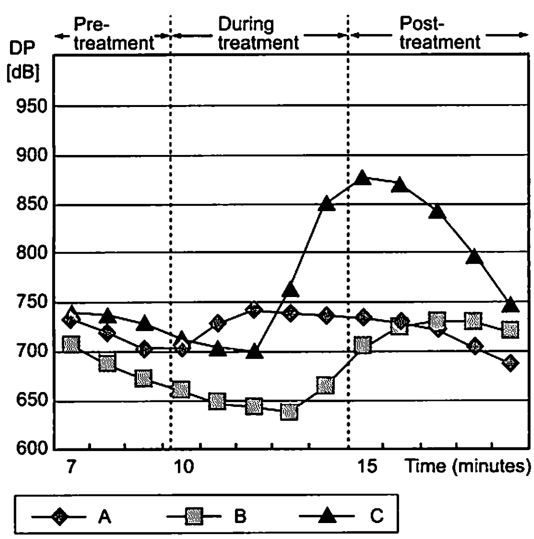

Fig. 5. Typical DP response pattern (stimulation group)

Table 2. DP comparison for each channel

	During treatment	Post-treatment	Total
CH1	0	14	14
CH2	2	13	15
CH3	0	15	15
CH4	1	10	11

(n=18)

2. Comparison of frequency

(1) Change in average frequency over time

Changes in average frequency over time for all test subjects are shown in Figures 6 and 7.

When the above frequency data for each channel was subject to analysis of variance, a trend toward variations within the normal range was observed, regardless of the subject's sex or condition of their stomach, without a significant difference over time. However, the non-stimulation group showed a slight trend toward decline compared to the stimulation group.

(2) Change in frequency

Examining individual frequency changes, Table 3 shows the number of people who exhibited variations within the normal frequency range during testing. For purposes of comparison, figures indicate the number of people who displayed changes relative to the control value both during and after treatment, as for the DP evaluation.

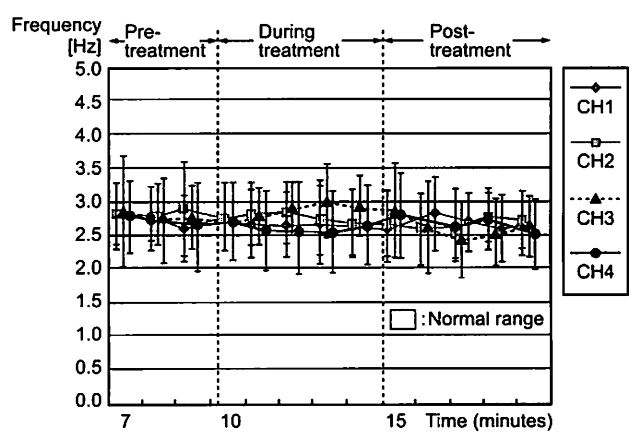

Fig. 6. Stimulation group

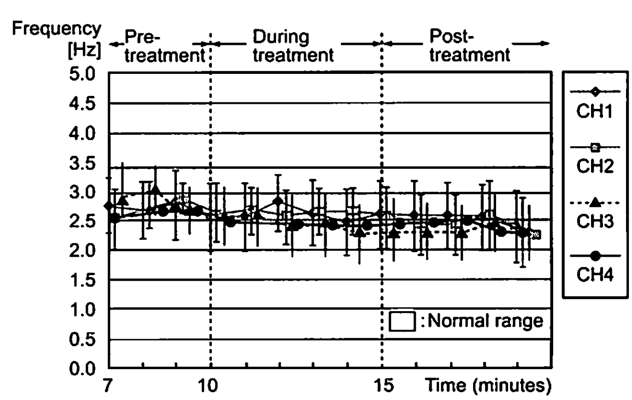

Fig. 7. Non-stimulation group

Table 4 lists results for cases displaying frequency variations outside the normal frequency range for each channel.

Table 5 indicates trends seen for all channels, taken from Table 4.

The above data of variations outside the normal frequency range indicate the same trend toward change occurring post-treatment as was observed in increases to DP, with post-treatment changes observed in 7 of the 12 cases in the stimulation group, which is significant.

Table 3. Subjects showing variations within the normal frequency range

Electrode	Non-stimulation group	Stimulation group
CH1	3 / 6	16 / 18
CH2	4 / 6	15 / 18
CH3	3 / 6	14 / 18
CH4	4 / 6	15 / 18

(Units: number of people)

Table 4. Variations outside the normal frequency range for each channel

Channel	Change	Pre-treatment	During treatment	Post-treatment	Number of cases: Stimulation group	Number of cases: Non-stimulation group
CH1	Change during treatment	—	○	—	1	
	Change during and post-treatment	—	○	○		2
	Change post-treatment	—	—	○	1	1
CH2	Change during treatment	—	○	—	1	1
	Change post-treatment	—	—	○	2	1
CH3	Change during treatment	—	○	—	2	1
	Change post-treatment	—	—	○	2	2
CH4	No change	—	—	—	1	
	Change during treatment	—	○	—		1
	Change during and post-treatment	—	○	○		1
	Change post-treatment	—	—	○	2	

— : Same frequency range as control value ○ : Change

Table 5. Variations outside the normal frequency range

	Pre-treatment	During treatment	Post-treatment	Stimulation group	Non-stimulation group
No change	—	—	—	1 / 12	0 / 10
Change during treatment	—	○	—	4 / 12	3 / 10
Change during and post-treatment	—	○	○	0 / 12	3 / 10
Change post-treatment	—	—	○	7 / 12	4 / 10

IV. Discussion

The fact that shiatsu stimulation of the crural region caused DP to increase in the electrogastrograph seems to indicate that it promoted gastrointestinal motility. The mechanism for this response may have been due either to stimulation of activity in the vagus nerve, which regulates the stomach, or inhibition of sympathetic nerve activity.

Sato et al have reported in detail on responses and neurological mechanisms involving stomach motility in anesthetized rats due to pinch stimulation[12] and acupuncture stimulation[13]. They reported conclusively that stimulation of the abdominal region suppressed stomach motility via a spinal segment reflex that stimulated the portion of the sympathetic nervous system supplying the stomach, while stimulation of the hind limb mildly stimulated stomach motility via a supraspinal reflex that stimulated activity in the vagus nerve, which regulates stomach function. Therefore, the mechanism behind the electrogastrograph response due to shiatsu stimulation of the crural region in healthy human subjects in this test is likely to be the same, despite differences in species and the presence or absence of anesthetic.

Noguchi et al[14] reported that duodenal motility was stimulated in anesthetized rats using electro-acupuncture stimulation of the footpad of the hind limb, and it is possible that the shiatsu stimulation of the crural region reported on herein also influenced duodenal and small intestine motility, in addition to stomach motility. Future study will be required to investigate the influence of shiatsu stimulation on intestinal motility.

Because the electrogastrograph electrodes were attached to the abdominal region, shiatsu stimulation was not implemented on the torso in this experiment due to the strong likelihood of artifact contamination due to shiatsu stimulation. However, because an increase in post-treatment electrogastrograph DP due to shiatsu stimulation of the crural region was observed here, we hope to test the effect of shiatsu stimulation of the torso in the future.

V. Conclusions

From this study performed on healthy adults, the following is evident:

Namikoshi-style shiatsu stimulation to the lateral crural region resulted in increased dominant power (DP). Frequency was within the normal frequency range and was unaffected.

In closing, we would like to express our appreciation to the instructors and students of the Japan Shiatsu College who participated in this research.

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